

Fig. 2 Output signal power against launched pump power.

the maximum diode driven current. The slope efficiency with respect to the launched pump power was 56% and the output signal power increased linearly with the launched pump power. We have not found any facet damage at the maximum power. So more output signal power can be realized if we increase pump power. Due to transient gain of the MOPA system,⁵ the amplified pulse duration is reduced from 30 to 15 ns at the repetition rate of 20 kHz, corresponding to a peak power of 300 kW. The pulse shortening factor increases with a decrease of repetition rate. Figure 3

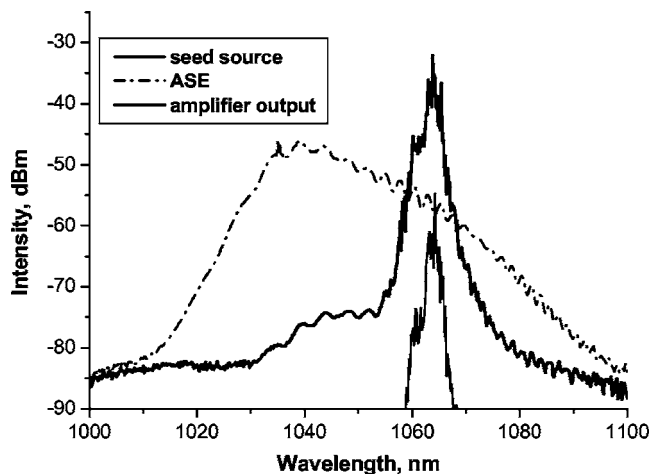


Fig. 3 Emitted spectrum of seed source, amplifier, and ASE.

shows the emitted spectrum at the maximum output signal power, plotted against the seed source spectrum and amplified spontaneous emission (ASE) on a logarithmic scale at the repetition rate of 100 kHz. When we pumped the fiber without the injection of seed source, the output spectrum was ASE spectrum and centered at 1040 nm with a 3-dB bandwidth of 20 nm, but when the seed source was coupled into the core, the output peak spectrum shifted to 1064 nm due to mode competition. The ASE spectrum was suppressed effectively and no stimulated Raman scattering occurs.⁶ Coiling the fiber in a diameter less than 10 cm discriminates against the higher order transversal mode through bending losses, and only lower order modes are amplified. The M^2 is characterized to be 3.2; the value could be improved with a smaller diameter cylindrical mandrel.

3 Conclusions

We have demonstrated a MOPA system that could produce a 133.8-W pulsed amplified output with M^2 beam quality of 3.2 at 1064 nm, using a 4-m homemade Yb-doped double-clad fiber, and the repetition rate is 100 kHz. The slope efficiency is 56% with respect to launched pump power. The maximum output signal power is limited by the available pump power. More powerful MOPA systems are expected in the near future, which will exploit new fields of application.

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